WHAT IS CLAIMED:

1. A multiple-ratio automatic transmission for an automotive vehicle comprising:

two gearsets for providing multiple torque flow paths between an engine and vehicle traction wheels, each gearset being characterized by at least two ratios that define multiple overall transmission ratios;

each gearset including a pressure-actuated friction element for establishing an upshift and a downshift between the two ratios;

a first controller for controlling pressure at the pressure-actuated friction element of one gearset; and

a second controller for controlling pressure at the pressure-actuated friction element of the other gearset;

one gearset being upshifted as the other gearset is simultaneously downshifted, thereby effecting a swap-shift in an overall transmission ratio;

the first and second controller having dynamic interaction compensation whereby a pressure change in one of the friction elements will command a pressure change in the other friction element during a time progression of the swap-shift, which results in improved quality of the swap-shift in the overall transmission ratio.

2. The automatic transmission set forth in claim 1 wherein the one gearset is downshifted and the other gearset is upshifted as the overall transmission ratio is upshifted.

3. The automatic transmission set forth in claim 1 wherein the one gearset is upshifted and the other gearset

is downshifted as the overall transmission ratio is downshifted.

4. The automatic transmission set forth in claim 1 wherein the controllers are speed-based, the transmission comprising a torque input element for the first gearset and a first speed sensor for monitoring the speed of the torque input element;

an intermediate shaft connecting a torque output element of the one gearset to a torque input element of the other gearset; and

a second speed sensor for monitoring the speed of the intermediate shaft;

the transmission further comprising an output shaft drivably connected to the vehicle traction wheels and a third speed sensor for monitoring the speed of the output shaft;

the controllers responding to speed information from the speed sensors to implement synchronization of an upshift and a downshift of the one gearset and the other gearset during a swap-shift to achieve an overall transmission ratio change.

5. The automatic transmission set forth in claim 1 wherein the simultaneous upshifting and downshifting of each gearset during a swap-shift occurs as the controllers control pressure at each friction element in a closed-loop fashion during progression of the swap-shift when engine power is being delivered to the traction wheels.

6. The automatic transmission set forth in claim 1 wherein the simultaneous upshifting and downshifting of each gearset during a swap-shift occurs as the controllers

control pressure at each friction element in an open-loop fashion during progression of the swap-shift when engine power delivery to the traction wheels is interrupted.

7. The automatic transmission set forth in claim 5 wherein the one gearset is downshifted and the other gearset is upshifted as the overall transmission ratio is upshifted.

8. The automatic transmission set forth in claim 5 wherein the one gearset is upshifted and the other gearset is downshifted as the overall transmission ratio is downshifted.

9. The automatic transmission set forth in claim 5 wherein the controllers are speed-based, the transmission comprising:

a torque input element for the first gearset and a first speed sensor for monitoring the speed of the torque input element;

an intermediate shaft connecting a torque output element of the one gearset to a torque input element of the other gearset; and

a second speed sensor for monitoring the speed of the intermediate shaft;

the transmission further comprising an output shaft drivably connected to the vehicle traction wheels and a third speed sensor for monitoring the speed of the output shaft;

the controllers responding to speed information from the speed sensors to implement synchronization of an upshift and a downshift of the one gearset and the other

gearset during a swap-shift for the overall transmission ratio.

10. The automatic transmission set forth in claim 6 wherein the one gearset is downshifted and the other gearset is upshifted as the overall transmission ratio is upshifted.

11. The automatic transmission set forth in claim 6 wherein the one gearset is upshifted and the other gearset is downshifted as the overall transmission ratio is downshifted.

12. A control method for controlling a multiple-ratio automatic transmission for an automotive vehicle including two gearsets controlled by pressure-actuated friction elements for providing multiple torque flow paths between an engine and vehicle traction wheels, each gearset having a controller, the method comprising the steps of:

measuring the input speed of one gearset and the input and output speeds of the other gearset;

monitoring shift progression and shift progression rate of the other gearset and the shift progression of the one gearset during a swap-shift;

transferring to the controller for the one gearset the shift progression and shift progression rate of the other gearset;

computing the desired input speed for the one gearset using the shift progression information from the other gearset during a swap-shift;

measuring actual input speed and controlling input speed error in a closed-loop fashion;

computing friction element command pressure for the one gearset;

converting pressure data from the controller for the one gearset to torque data for the one gearset using friction element gain data for the one gearset;

converting torque data from the one gearset to torque data for the other gearset;

converting torque data from the other gearset to a first interactive pressure value for the other gearset using friction element gain data for the other gearset;

controlling friction element pressure for the friction element of the other gearset in a closed-loop fashion during a swap-shift using input and output speed information for the other gearset; and

transferring information regarding the interactive pressure value to the other gearset for modifying the friction element pressure for the friction element of the other gearset, whereby compensation for dynamic interaction is effected for the gearsets during swap-shifts.

13. A control method for controlling a multiple-ratio automatic transmission for an automotive vehicle including two gearsets controlled by pressure-actuated friction elements for providing multiple torque flow paths between an engine and vehicle traction wheels, the method comprising the steps of:

measuring the input speed of one gearset and the input and output speeds of the other gearset;

monitoring shift progression and shift progression rate of the other gearset and the shift progression of the one gearset during a swap-shift;

transferring to the controller for the one gearset the shift progression and shift progression rate of the other gearset;

computing the desired input speed for the one gearset using the shift progression information from the other gearset during a swap-shift;

measuring actual input speed and controlling input speed error in a closed-loop fashion;

computing friction element command pressure for the one gearset;

computing friction element command pressure for the other gearset;

converting pressure data from the controller for the one gearset to torque data for the one gearset using friction element gain data for the one gearset;

converting torque data from the one gearset to torque data for the other gearset;

converting torque data from the other gearset to a first interactive pressure value for the other gearset using friction element gain data for the other gearset;

converting pressure data from the controller for the other gearset to torque data for the other gearset using friction element gain data for the other gearset;

converting torque data from the other gearset to torque data for the one gearset;

converting torque data from the one gearset to a second interactive pressure value for the one gearset using friction element gain data for the one gearset;

controlling friction element pressure for the friction element of the other gearset in a closed-loop fashion during a swap-shift using input and output speed information for the other gearset;

controlling friction element pressure for the friction element of the one gearset in a closed-loop fashion during a swap-shift using input speed information and output shaft speed information for the one gearset;

transferring information regarding the first interactive pressure value to the other gearset for modifying the friction element pressure for the friction element pressure of the other gearset; and

transferring information regarding the second interactive pressure value to the one gearset for modifying the friction element pressure for the friction element pressure of the one gearset;

the controllers for the one gearset and the other gearset compensating for dynamic interaction of the gearsets during an inertia phase of a swap-shift.

14. The method set forth in claim 12 including the step of providing independent starting and ending control of the ratio change for each gearset, whereby the start of a ratio change for the one gearset occurs after the start of a ratio change for the other gearset during a swap-shift.

15. The method set forth in claim 12 including the step of providing independent starting and ending control of a ratio change for each gearset, whereby the start of a ratio change for the one gearset occurs substantially simultaneously with respect to the start of a ratio change for the other gearset during a swap-shift.

16. The method set forth in claim 13 including the step of providing independent starting and ending control of the ratio change for each gearset, whereby the

start of a ratio change for the one gearset occurs after the start of a ratio change for the other gearset during a swap-shift.

17. The method set forth in claim 13 including the step of providing independent starting and ending control of a ratio change for each gearset, whereby the start of a ratio change for the one gearset occurs substantially simultaneously with respect to the start of a ratio change for the other gearset during a swap-shift.

18. The method set forth in claim 12 including the step of starting and ending control of the ratio change for each gearset whereby the end of a ratio change for the one gearset occurs before the end of a ratio change for the other gearset during a swap-shift.

19. The method set forth in claim 12 including the step of starting and ending control of the ratio change for each gearset whereby the end of a ratio change for the one gearset occurs substantially simultaneously with respect to the end of a ratio change for the other gearset during a swap-shift.

20. The method set forth in claim 13 including the step of providing independent starting and ending control of a ratio change for each gearset whereby a ratio change for the one gearset ends before the end of the ratio change for the other gearset during swap-shift.

21. The method set forth in claim 13 including the step of providing independent starting and ending control of a ratio change for each gearset whereby a ratio

change for the one gearset ends substantially simultaneously with the end of the ratio change for the other gearset.

22. The method set forth in claim 13 including the step of controlling actuating pressure for the friction element of the other gearset in a closed-loop fashion, the closed-loop control being initiated independently of the controller for the one gearset, whereby premature closed-loop control of the friction element of the one gearset is avoided.

23. The method set forth in claim 13 including the step of controlling independently the length of time a swap-shift is in a closed-loop control for the friction elements of each gearset.

24. The method set forth in claim 13 including the step of computing acceleration of elements of each gearset and using the acceleration information to compute internal inertia torques of the gearset elements; and

calculating starting torques for both the one and the other gearsets using the internal inertia torque information, the controllers for the one gearset and the other gearset compensating for gearset element accelerations that occur during a swap-shift as starting torques are calculated, thereby independently initiating a start of a ratio change in each gearset.

25. The method set forth in claim 12 including the step of interrupting closed-loop control of the shift progression for the gearsets when engine power is off and the traction wheels are moving and initiating open-loop

control of the friction elements of each gearset during a swap-shift.

26. The method set forth in claim 13 including the step of interrupting closed-loop control of the shift progression for the gearsets when engine power is off and the traction wheels are moving and initiating open-loop control of the friction elements of each gearset during a swap-shift.

27. A multiple-ratio automatic transmission for an automotive vehicle having an engine, a torque converter with an impeller connected to the engine and a turbine, the transmission comprising:

a first planetary gearset with at least two ratios having a pressure-actuated brake element for effecting one gear ratio for the first planetary gearset and a pressure-actuated clutch element for effecting another gear ratio for the first planetary gearset;

a second planetary gearset having at least three ratios having a first pressure-actuated element for effecting one gear ratio for the second planetary gearset, a second pressure-actuated element for effecting a second gear ratio for the second planetary gearset and a third pressure-actuated element for effecting a third gear ratio for the second planetary gearset;

the first and second planetary gearsets providing multiple torque flow paths between the engine and vehicle traction wheels;

a torque input shaft for the second planetary gearset being connected to a torque output shaft of the first planetary gearset;

a torque output shaft for the second planetary gearset being drivably connected to the traction wheels;

a first speed-based controller for controlling pressure at the pressure-actuated friction elements of the one gearset;

a second speed-based controller for controlling pressure at the pressure-actuated friction elements of the second gearset;

a first speed sensor for monitoring the speed of the turbine;

a second speed sensor for monitoring the speed of the torque output shaft of the first gearset; and

a third speed sensor for monitoring the speed of the torque output shaft of the second planetary gearset;

one gearset being upshifted as the other gearset is being downshifted, thereby effecting a swap-shift for the overall transmission ratio;

the first and second controllers having dynamic torque-based interaction based upon monitored speed sensor information, whereby a pressure change in one of the friction elements will command a pressure change in the other friction element during a time progression of the swap-shift, which results in improved quality of the swap-shift in the overall transmission ratio.

28. The transmission set forth in claim 27 wherein the first gearset is downshifted and the second gearset is upshifted as the overall transmission ratio is upshifted during a swap-shift event.

29. The transmission set forth in claim 27 wherein the first gearset is upshifted and the second

gearset is downshifted as the overall transmission ratio is downshifted during a swap-shift event.

30. The transmission set forth in claim 27 wherein the first and second controllers each include central processors with stored control algorithms for effecting pressure control of the pressure-actuated friction elements involved in a swap-shift, whereby the second controller, during upshifts and downshifts of the second gearset, responds to transient torque changes in the power flow path established by the first planetary gearset.

31. The transmission set forth in claim 27 wherein the first and second controllers each include a central processor with stored algorithms for effecting a pressure control of pressure-actuated friction elements involved in a swap-shift, whereby the first controller, during upshifts and downshifts of the first gearset, responds to shift progression and shift progression rate information for the second gearset to delay a start of ratio change control for the first gearset until after a calibrated ratio change progression of the second gearset is reached, thereby improving swap-shift quality by reducing transient inertia torque disturbances.

32. The transmission set forth in claim 30 wherein the first gearset is downshifted and the second gearset is upshifted as the overall transmission ratio is upshifted during a swap-shift event.

33. The transmission set forth in claim 31 wherein the first gearset is upshifted and the second

gearset is downshifted as the overall transmission ratio is downshifted during a swap-shift event.

34. The transmission set forth in claim 27 wherein the first and second controllers effect open-loop control of the pressure-actuated friction elements involved in a swap-shift when engine power is off.

35. The transmission set forth in claim 34 wherein the first gearset is downshifted and the second gearset is upshifted as the overall transmission ratio is upshifted during a swap-shift event.

36. The transmission set forth in claim 34 wherein the first gearset is upshifted and the second gearset is downshifted as the overall transmission ratio is downshifted during a swap-shift event.

37. An automatic transmission for an automotive vehicle comprising:

a simple planetary gearset and a compound planetary gearset arranged in series to establish multiple torque flow paths between an engine and vehicle traction wheels;

a first pressure-actuated reaction brake for anchoring a sun gear of the simple planetary gearset to establish an upshift of the simple planetary gearset on an overall transmission ratio downshift;

a second pressure-actuated reaction brake for anchoring a sun gear of the compound planetary gearset to establish an upshift of the compound planetary gearset on the overall transmission ratio downshift;

a ring gear of the simple planetary gearset being drivably connected to a torque input element of the compound planetary gearset;

a first controller for controlling pressure at the pressure-actuated reaction brake for the simple planetary gearset; and

a second controller for controlling pressure at the pressure-actuated reaction brake for the compound planetary gearset;

the first and second controllers having dynamic interaction whereby a pressure change at one of the pressure-actuated reaction brakes will command a pressure change at the other pressure-actuated reaction brake during a swap-shift, which results in improved quality of the swap-shift in the overall transmission ratio.

38. The automatic transmission set forth in claim 34 wherein the first controller controls pressure at the first pressure-actuated reaction brake to establish a downshift of the simple planetary gearset in an overall transmission ratio upshift;

the second controller controlling pressure at the second pressure-actuated reaction brake to establish a downshift of the compound planetary gearset in the overall transmission ratio downshift;

the first and second controllers having dynamic interaction whereby a pressure change at one of the pressure-actuated reaction brakes will command a pressure change at the other pressure-actuated reaction brake during a swap-downshift, which results in improved quality of the swap-shift in the overall transmission ratio.

39. An automatic transmission for an automotive vehicle comprising a simple planetary gearset and a compound planetary gearset arranged in series to establish multiple torque flow paths between an engine and vehicle traction wheels;

a pressure-actuated reaction brake for anchoring a sun gear of the simple planetary gearset to establish an upshift of the simple planetary gearset in an overall transmission ratio downshift;

a pressure-actuated clutch for drivably connecting two elements of the compound planetary gearset to establish a downshift of the compound planetary gearset on the overall transmission ratio downshift;

a ring gear of the simple planetary gearset being drivably connected to a torque input element of the compound planetary gearset;

a first controller for controlling pressure at the pressure-actuated reaction brake for the simple planetary gearset; and

a second controller for controlling pressure at the pressure-actuated clutch for the compound planetary gearset;

the first and second controllers having dynamic interaction whereby a pressure change at the pressure-actuated reaction brake will command a pressure change at the pressure-actuated clutch during a swap-upshift which results in an improved quality of the swap-shift in the overall transmission ratio.

40. The automatic transmission set forth in claim 39 wherein the first controller controls pressure at the pressure-actuated reaction brake to establish a downshift of

the simple planetary gearset in an overall transmission ratio upshift;

the second controller controlling pressure at the pressure-actuated clutch for the compound planetary gearset;

the first and second controllers having dynamic interaction whereby a pressure change at the pressure-actuated reaction brake will command a pressure change at the pressure-actuated clutch during a swap-downshift which results in improved quality of the swap-shift in the overall transmission ratio.